

REMARKS

Applicant thanks the Examiner for acknowledging Applicant's claim to foreign priority under 35 U.S.C. § 119(a)-(d), and for indicating that the certified copy of the priority document has been received.

Drawings:

Applicant thanks the examiner for indicating that the drawings have been accepted.

Claim Objections:

The Examiner has objected to claim 1, and the Applicant has amended claim 1 as shown in the previous section. Applicant hereby requests the Examiner reconsider and withdraw the above objection to the claim.

Claim Rejections:

Claims 1-6 are all the claims pending in the application, and currently all of the claims stand rejected.

35 U.S.C. § 103(a) Rejection – Claims 1, 2 and 4-6:

Claims 1, 2 and 4-6 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,256,849 to Kim, in view of JP 404257446 to Mukoyama. In view of the following discussion, Applicant respectfully disagrees.

As previously discussed by the Applicant (in previous responses), the present invention of the application has a structure of extending the lower electrode from an area facing the pressure generating chamber to an area facing the compartment walls which are present on both sides.

Additionally, the present invention of the application sets a relationship between the width of the piezoelectric layer formed on the lower electrode on the pressure generating chamber side and that of the pressure generating chamber on the piezoelectric element side is $0.75 \leq x/y \leq 1$. This aspect of the present invention is not disclosed, taught or suggested in the Kim reference. To teach this aspect of the present invention, the Examiner relies on the teachings of the Mukoyama reference.

With regard to the Mukoyama reference, Applicant has the following comments.

In describing the device in Mukoyama, it is stated that "according to the foregoing configuration of the present invention [i.e. the Mukoyama disclosure], a deformation of the piezoelectric layer becomes largest when the voltage is fixed. Thus, it is possible to efficiently spout ink." See para. 0006. Furthermore, in paragraph 0009, there is a description that "... A piezoelectric element 30 has a characteristic of contraction when the voltage is applied thereto. Utilizing this characteristic, the piezoelectric element 30 is contracted by applying the voltage thereto, thus deforming the base plate 10....". Para. 0009.

In addition, with regard to Figure 4, Mukoyama indicates that this figure is a graph showing the result of measuring the volume of ink ejected from the pressure chamber 20 while changing the width 30a of the piezoelectric element 30, given that the length of the pressure chamber 20 is 5.5 mm and the width 20a is 1.2 mm. The longitudinal axis shows the volume of ink ejected from the pressure chamber 20 per unit voltage when applying the unit voltage to the piezoelectric element 30. The lateral axis shows the width 30a of the piezoelectric element 30.

As can be seen from Fig. 4, the largest volume of ink is ejected when the width 30a of the piezoelectric element 30 is equal to the width 20a of the pressure chamber 20. Para. 0012.

When reviewing this disclosure, along with the disclosure set forth in Paragraphs 0013 and 0014, it is clear that the "piezoelectric element" in Mukoyama is a "piezoelectric active section". Specifically, these paragraphs state:

[0013] Fig. 5 shows the same calculation result as that of Fig. 4. However, Fig. 5 indicates the lateral axis as a piezoelectric element width/a pressure chamber width. As can be seen from Fig. 5, the largest volume of ink is ejected from the pressure chamber 20, when the ratio of the width of the piezoelectric element 30 to that of the pressure chamber 20 is 0.8 to 1.0, which is a range where ink drops are efficiently spouted. If the ratio of the width of the piezoelectric element 30 to that of the pressure chamber 20 is equal to or greater than 1.0, the ejection volume decreases suddenly. This is because the piezoelectric element 30 is restrained by the print head base plate 10 in a portion other than the pressure chamber 20, thus making it impossible to obtain the sufficient amount of deformation.

[0014] Further, also when the ratio of the width of the piezoelectric element 30 to that of the pressure chamber 20 is equal to or less than 0.8, the decrease of the ejection volume is significant, although it does not occur suddenly. This is because the width 30a of the piezoelectric element 30 is too narrow relative to the width 20a of the pressure chamber 20 so that the amount of the deformation of the piezoelectric element 30 is small. Thus, the sufficient amount of the deformation cannot be obtained for the entire pressure chamber. Therefore, since it is sufficient if the ratio of the width of the piezoelectric element 30 to that of the pressure chamber 20 is within a range from 0.8 to 1.0, it is possible to prevent time from being wasted in design and production by repeated trials and errors. Additionally, if the ratio of the width of the piezoelectric element 30 to that of the pressure chamber 20 is within a range from 0.8 to 1.0, it is most efficient to spout ink drops. Thus, a low voltage is enough to drive the ink jet recorder, and the costs for a circuit and a base plate can be suppressed low since it is possible to drive the recorder at a low driving voltage.

Because of this disclosure, Applicant submits that the above references fail to render the claimed invention obvious.

Specifically, when reviewing the Mukoyama reference, this reference teaches that there is a change in ink ejection voltage, not in accordance with the width of the piezoelectric active section but that of the piezoelectric element, and there is no description that at least one of the upper and lower electrodes is different in width from the piezoelectric layer. Additionally, when reviewing the figures of Mukoyama, in which the entire piezoelectric element is shown, there is no evidence of discriminating between the upper electrode, the piezoelectric layer and the lower electrode. In light of this, the "piezoelectric element" in the reference Mukoyama is the "piezoelectric active section" which is a section where a displacement attributed to the ink ejection is caused.

Therefore, a skilled artisan would not have found it obvious to combine this reference with Kim, and even if it were combined, the resultant combination would fail to teach or suggest each and every feature of the claimed invention.

Furthermore, with regard to the Kim reference, the shape of the cross section of the piezoelectric layer of the piezoelectric element is trapezoidal. However, when viewed by those skilled in the art, the section interposed between the lower and upper electrodes is a piezoelectric active section in the shown piezoelectric element.

Therefore, when combining Mukoyama and Kim, a skilled artisan would make a piezoelectric active section in a trapezoidal shape, with a width relationship to the pressure

generating chamber. Thus, at best, the combination of these references teach a relationship between the widths of the piezoelectric active section and the pressure generating chamber.

Thus, Mukoyama and Kim are fundamentally different from the present invention, in which the relationship between the width of the "piezoelectric layer" on the pressure generating chamber side and that of the pressure generating chamber on the piezoelectric element side is stipulated. Stated differently, the present invention is directed to a relationship between the width of a PZ layer on the pressure generating chamber side, and the pressure generating chamber. Applicant submits that a relationship regarding a PZ active section (the prior art) fails to teach or suggest the claimed relationship, which is with regard to the PZ layer.

Because of the novel aspects of the present invention, the rigidity of the vibration plate increases and it is possible to suppress an increase in the amount of initial displacement of the vibration plate due to residual distortion caused in the piezoelectric element by repeatedly driving the piezoelectric element. This is achieved by stipulating the width of the piezoelectric layer on the pressure generating chamber side and that of the pressure generating chamber on the piezoelectric layer side in a predetermined range while setting the shape of the cross section of the piezoelectric layer to be trapezoidal. These effects are not indicated in Mukoyama and Kim, and cannot be achieved by either of these references, either individually or in combination. In view of the foregoing, Applicant submits that it would not have been obvious to combine the teachings of the above cited references, as suggested by the Examiner. Further, even if the above references were combined, they would fail to teach or suggest each and every feature of the claimed invention. Therefore, Applicant submits that the Examiner has failed to establish a

prima facie case of obviousness as required under 35 U.S.C. § 103(a). Accordingly, Applicant hereby requests the Examiner reconsider and withdraw the above 35 U.S.C. § 103(a) rejection of the claims.

35 U.S.C. § 103(a) Rejection – Claim 3:

Claim 3 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Kim in view of Mukoyama, in further view of JP 410286960 to Hashizume. In view of the following discussion, Applicant respectfully traverses the above rejection.

As an initial matter, Applicant notes that Hashizume fails to cure the deficient teachings of Kim and Mukoyama, and is thus allowable over the prior art, at least because of its dependence.

Additionally and independently, contrary to the Examiner's assertions, Applicant submits that a skilled artisan would not combine the references as suggested by the Examiner. Specifically, a skilled artisan would not combine the references to have a space portion and a relationship between the width of the space portion and that of the piezoelectric layer on the pressure generating chamber side is set within the predetermined range. For similar reasons to those discussed above regarding claim 1, the combination of these references would fail to teach or suggest the claimed relationship regarding the PZ "layer."

In view of the foregoing, Applicant submits that it would not have been obvious to combine the teachings of the above cited references, as suggested by the Examiner. Further, even if the above references were combined, they would fail to teach or suggest each and every feature of the claimed invention. Therefore, Applicant submits that the Examiner has failed to

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establish a *prima facie* case of obviousness as required under 35 U.S.C. § 103(a). Accordingly, Applicant hereby requests the Examiner reconsider and withdraw the above 35 U.S.C. § 103(a) rejection of the claims.

Conclusion:

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

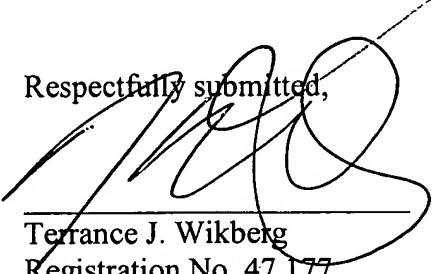
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